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FOREIGN TECHNOLOGY DIVISION

AIR FORCE SYSTEMS COMMAND

VERTICAL TEMPERATURE DISTRIBUTION IN A FREE ATMOSPHERE WHEN ITS VALUES AT THE SURFACE OF THE EARTH ARE SPECIFIED

by

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FOREIGN TECHNOLOGY DIVISION

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VERTICAL TEMPERATURE DISTRIBUTION IN A FREE ATMOSPHERE WHEN ITS VALUES AT THE SURFACE OF THE EARTH ARE SPECIFIED

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ABSTRACT (U) Temperature distribution and its variation as a function of altitude is considered. The average temperature profile is compared with the vertical temperature distribution which is averaged out for assigned readings at the surface of the earth. The question of grouping surface temperature in order to obtain its vertical variation for specified surface values is clarified. The effect of the vertical temperature distribution is illustrated by considering data obtained at the Keflavik (Iceland) and Sapporo (Hokkaido) stations. Temperature characteristics were obtained by processing aerological observation data for the period from 1957 to 1961. The variation in the average temperature as a function of altitude for these two stations is tabulated and plotted, and the climatological conditions responsible for the difference in the two curves are discussed. Correlation factors are established between the surface temperature of the earth and temperature on the isobaric surfaces at Keflavik. The correlation between the temperature at the surface of the earth and at upper levels (700-500 millibars) is weak. Information on correlation at Sapporo was not available. The difference between temperature values obtained by individual radio balloon flights, the average temperature for a specified extreme gradation and the average temperature at the surface of the earth and on the main isobaric surfaces are tabulated for Sapporo. The results show that the difference between the temperature obtained by individual balloon lflights and the average temperature for the specified gradation at the surface of the earth is smaller in the troposphere than the difference between the temperature measured by

individual balloon flights and the average temperature irrespective of grouping at the surface of the earth. It is concluded that the grouping of surface temperature when it is subject to large variations at the specified points defines the vertical temperature distribution in the troposphere only for the extreme temperature gradations at the surface of the earth. The vertical variation of the average temperature in these gradations is two to three times more accurate in reflecting the vertical stratification than the overall average temperature (irrespective of the grouping at the surface of the earth). When the temperature variations at the surface of the earth are small, it is not expedient to break down this surface temperature into gradations. Orig. art. has: 3 figures and 7 tables.

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Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

* ye initially, after vowels, and after ъ, ь; e elsewhere. When written as ё in Russian, transliterate as yё or ё. The use of diacritical marks is preferred, but such marks may be omitted when expediency dictates.

VERTICAL TEMPERATURE DISTRIBUTION IN A FREE ATMOSPHERE WHEN ITS VALUES AT THE SURFACE OF THE EARTH ARE SPECIFIED

I. M. Moskaleva

Temperature distribution and its variability with altitude are examined. The average temperature profile is compared with vertical temperature distribution which is averaged out for assigned readings at the surface of the earth. The question of the expediency of grouping surface temperature in order to obtain its vertical variation at specified temperature values at the surface of the earth is clarified.

A study of basic regularities in the distribution of meteorological elements with altitude and exposure of their connection with ground conditions are all the more necessary for solving a whole number of practical problems. At present there is an increasing number of investigations on clarification of vertical connections between meteorological elements at the surface of earth and on different levels of the troposphere and lower stratosphere. Certain results of these works, in particular those dedicated to the method for calculation and study of vertical correlation bonds of temperature over individual regions of the northern hemisphere, are published in works [2, 4].

In connection with fulfillment of one of the practical problems vertical temperature distribution was obtained as well as the recurrence of its different values on isobaric surfaces both for

specific values of surface temperature grouped by readings, and also on the whole independently of its grouping at the surface of the earth. In comparing curves of vertical stratification for two regions the question arose as to whether or not it was expedient to group surface temperature and to use its vertical distribution, depending on the assigned temperature value at the surface of the earth.

This article is devoted to a consideration of vertical characteristics of temperature and clarification of the stated dependence.

Exposure of the nature of vertical temperature distribution depending on its surface value is illustrated in an example from stations at Keflavik (Iceland) and Sapporo (Hokkaido). For obtaining the stated temperature characteristics mechanically processed aerological observations for the 5-year period from 1957 through 1961 for winter and summer were used.

In obtaining the characteristics of temperature distribution at different levels depending on surface temperature the entire aggregate of surface values of temperature was preliminarily split into 5-degree gradations. Joint processing of the material from ground and high-altitude observations was carried out on machines for each reading of ground temperature separately. Here were calculated the average temperature on each isobaric surface, recurrence of temperature by reading, and standard deviation of temperature on the basis of distribution according to the accepted 5-degree readings.

It is obvious that the number of cases in different gradations was nonuniform. The largest number of observations belonged to middle gradations. In extreme gradations, close to extreme temperature values, the number of observations is small. Another peculiarity of the material is the considerable decrease in the number of observations of temperature with altitudes greater than 16-20 km.

Considering these peculiarities the calculation of mean values of temperature on the corresponding isobaric surfaces for each gradation of surface temperature was carried out only when the

number of observations was 10 and more. Standard deviation of temperature was calculated when the number of observations was no less than 40. For gradations of surface temperature which were close to its extreme values the standard deviation was not calculated.

Before making a comparison of vertical variation of general average temperature and temperature averaged for each graduation at the surface of earth, we will examine the peculiarities of average vertical temperature profile (independent of grouping at the earth) and variability of temperature with altitude.

1. Peculiarities of Vertical Variation of Average Temperature and Its Variability with Altitude

In winter over the examined regions in the troposphere and lower stratosphere up to 16 km there is a general drop in temperature with height (Fig. 1, Appendices 1 and 2). In spite of the more northern position of the Keflavik station (income of total radiation four times less than at Sapporo), the average temperature at the surface of the earth was higher: 0.2° in Keflavik and - 2.5° in Sapporo.

Table 1 gives data of surface temperature for these stations.

Table 1. Recurrence of surface temperature (in %, in parentheses – number of cases) in winter.

Station	Temperature reading						
	от −19.9 до −15.0	от −14.9 до −10.0	от −9.9 до −5.0	от −4.9 до −0.0	0.1—4.9	5.0—9.9	10.0—14.9
Keflavik		0 (1)	13 (65)	30 (148)	46 (221)	11 (55)	
Sapporo	0 (1)	4 (16)	26 (10[illegible])	43 (160)	21 (6[illegible])	5 (18)	1 (4)

The greatest recurrence of temperature in Keflavik was apportioned to gradations with higher values of surface temperature than in Sapporo. Such a relationship of temperature over the points under consideration is preserved in the lower and middle troposphere, where the difference in average temperatures on the corresponding levels comprises 2-3°.

Peculiarities of temperature field at the surface of the earth and in the lower troposphere are formed to a considerable degree under the influence of warm sea currents. The degree of their influence on air temperature is indicated by the quantity of heat brought in by sea currents. According to [1] the warm current of the Gulf Stream carries in to the region of Iceland (Keflavik) for each square centimeter in a year heat which is equal to approximately 50 kcal/cm^2 i.e., the same quantity which the given area receives in the form of total radiation for almost the entire warm half of the year.

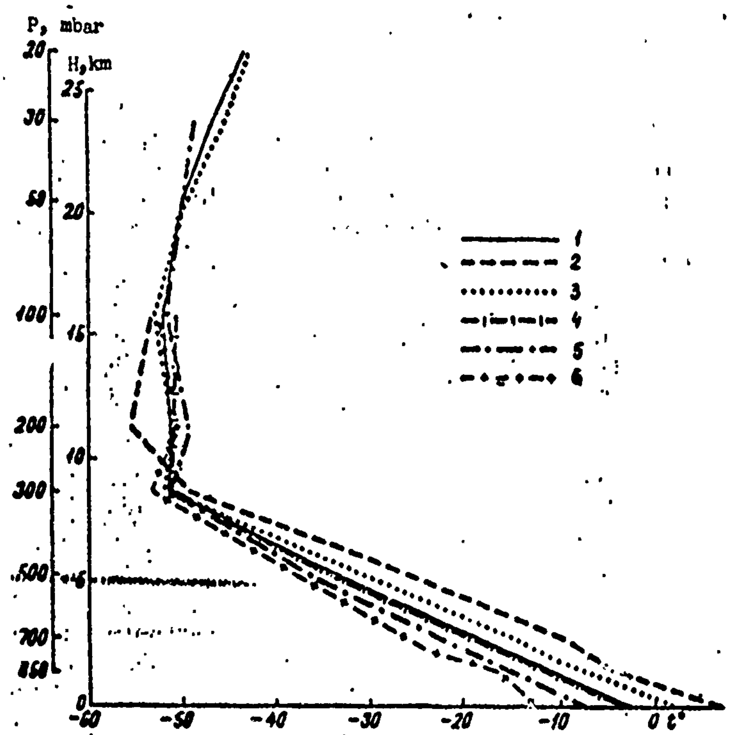

Fig. 1. Average air temperature (Sapporo, winter), obtained regardless of grouping of temperature at the surface of the earth (1) and for assigned readings of surface temperature: 2 – from 5.0 to 9.9°; 3 – from 0.0 to 4.9°; 4 – from -0.1 to -4.9; 5 – from -5.0 to -9.9°; 6 – from -10.0 to -11.9°.

The warming influence of the Japanese current in the region of Hokkaido (Sapporo) is established with a value near 30 kcal/cm^2 a year. However, the proximity of Hokkaido to the Asian mainland,

from which intrusions of cold air frequently emanate, conditions a lower temperature here for the given latitude in the whole layer of the troposphere.

In winter the surface waters of the ocean (both in the region of Iceland and Hokkaido) are warmer than the air, thanks to which the stratification of the air becomes unstable [3]. Vertical temperature gradients in the lower layer (earth -850 mbar comprise 0,5—0,6°/100 м. Above this level in the troposphere the drop in temperature with height is characterized by a comparatively constant value of gradient – around 0.5-0.6°/100 m.

In the lower stratosphere over the more norther station (Keflavik) low temperature values are observed which are connected with winter radiation conditions at these altitudes. Here at an altitude of 24 km (30 mbar) minimum temperatures are -80.0 and -84.9°. Over Sapporo the minimum temperatures at these altitudes are -55.0 and -59.9°. Let us remember that the conditions of the lower stratosphere in this region are determined to a considerable degree by the presence of the Pacific Ocean area of warmth.

In connection with peculiarities of conditions in the lower stratosphere fluctuations in temperature during winter above Keflavik and Sapporo are different. Over Keflavik, where against a background of low temperature values in the lower stratosphere explosive rises in temperature are observed, fluctuations in temperature are considerable (40°) and exceed fluctuations at the surface of the earth (Table 1). In Sapporo the range of temperature fluctuations comprise 25-30°, just as in the lower troposphere.

Let us trace the nature of temperature distribution over the two examined stations with the help of standard deviations (Appendix 1).

In the lower layer (earth -850 mbar) variability of temperature at each point comprises 4-5°, increasing in the middle troposphere up to 6.1-6.3°. This is caused by the frequent replacement of baric

formations. In the upper troposphere fluctuations of temperature decrease; the standard deviation of temperature here comprises approximately 4°. At these levels, as it is know, maximum winds which are connected with small horizontal temperature gradients are observed, i.e., a levelling off of values of horizontal temperature takes place.

The sharply expressed maximum of standard deviations of temperature over Keflavik (7.1°) and the not so sharp ones over Sapporo (5.5°) coincide with the level of fluctuation of the tropopause.

The lower stratosphere over Sapporo is characterized by the greatest stability of processes, whereas in Keflavik the temperature fluctuations are considerable (σ_t = 8-9°).

In summer the differences in temperature over the examined regions at the surface of the earth and in troposphere are expressed more sharply than in winter. Ground temperature in Sapporo is 20.4° and in Keflavik 10.5° (Fig. 2). In Sapporo a temperature of 20.0-24.9° at the surface of earth is repeated most frequently (41%) while in Keflavik this temperature is maximum and was noted only once (Table 2).

Table 2. Recurrence of surface temperature (in %, in parentheses - number of cases) in the summer.

Station	Gradation of temperature						
	0.0–4.9	5.0–9.9	10.0–14.9	15.0–19.9	20.0–24.9	25.0–29.9	30.0–34.9
Keflavik	1 (3)	35 (183)	62 (329)	2 (11)	0 (1)		
Sapporo		1 (3)	11 (56)	34 (166)	41 (201)	10 (47)	3 (17)

Latitudinal differences in the position of the stations and also peculiarities of summer circulation in the region the Japanese Islands, in particular the influence of the heated Asian mainland with the existing high degree of recurrence of western winds, condition higher values of temperature here. In Sapporo the average air temperature of the troposphere up to an altitude of 9 km remains higher than in Keflavik by approximately 10° (Appendix 2).

Thanks to the influence of surface waters (water colder than air) convection in the lowest layer is developed weakly. Here surface inversions are frequently observed.

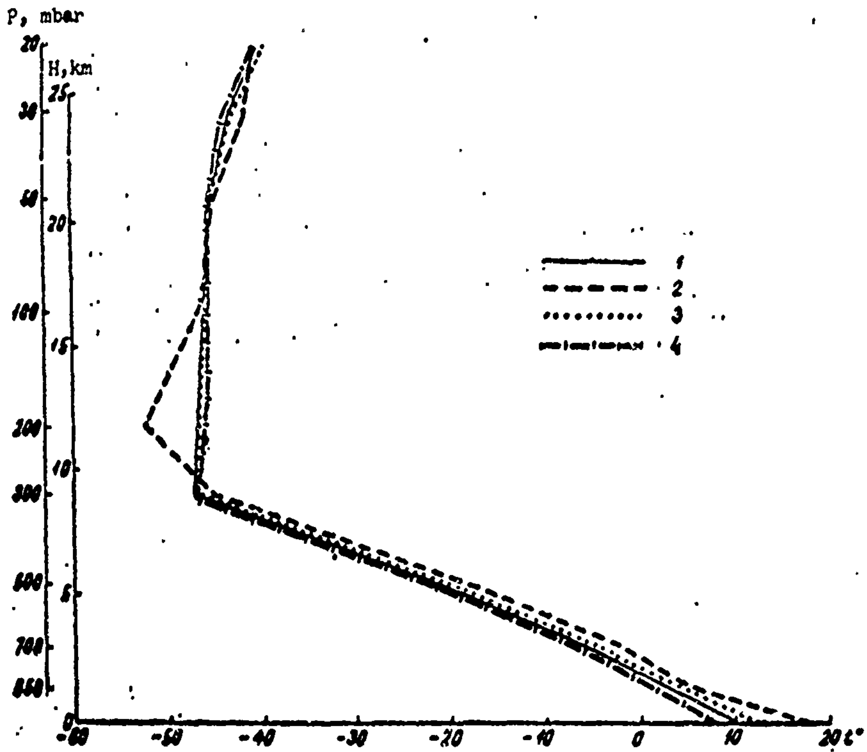

Fig. 2. Average air temperature (Keflavik, summer), obtained independently of grouping of temperature at the surface of earth (1) and for assigned gradations of surface temperature: 2 – from 15.0 to 19.9°; 3 – from 10.0 to 14.9°; 4 – from 5.0 to 9.9°.

Above 10 km the differences in temperature are somewhat evened out, however, over Sapporo the lowest temperatures are preserved in the upper troposphere and lower stratosphere. On an isobaric surface of 30 mbar in Sapporo the recurrance of temperature gradation from -50.0 to -54.9° comprises 20%; in Keflavik these temperature values have a probability of 1%.

A comparison of standard deviations of temperature in winter and in the summer shows the differences in seasonal processes determining the high degree of variability of temperature in the winter and the small degree in the summer. This is especially

characteristically for the lower and middle troposphere in Keflavik. In the middle troposphere in the summer the values of standard deviation comprise 3.5° in Keflavik and 4.5° in Sapporo. Just in winter, the increase in variability of temperature with altitude in the summer is connected with fluctuations of the tropopause. In the lower stratosphere variability is small (2.5-3.5°).

The value of standard deviation of temperature and recurrence of temperature in different gradations on the corresponding isobaric surfaces for general average temperature (independent of the grouping at the surface of the earth) are given in the appendices.

Thus on the force of circulation peculiarities, for the two examined regions a difference is characteristic in the distribution of surface temperature both in winter and in summer. Due to seasonal fluctuations of these processes considerable variability of temperature is noted in the winter and less in the summer. Below we will examine the peculiarities of vertical movement of temperature for assigned gradations of temperature at the surface of the earth in these regions.

2. Connection Between Temperature of Free Atmosphere with the Temperature at the Surface of the Earth

Division of surface temperature by gradations and the obtaining of average vertical profile for each of them make it possible to conduct a comparison of the results of such averaging with vertical course of average yearly temperature, independent from the grouping at the surface of the earth. If the mean vertical profiles for each gradation had a vertical course repeating the course of the curve of temperature change with altitude, calculated independently of the grouping at the surface of the earth, then, considering the properties of the curves it would have been possible to apply the known method of extrapolation to them. This assumes that starting with some altitude for the vertical profiles of each surface gradation of temperature there exists an independent connection of vertical temperature. Whereupon the value of correlation coefficients can be found as a result of treatment of all cases of observations independently of their value at the surface of the earth. An analysis

of such values of correlation coefficients, which are given in Table 3, makes it possible to draw the conclusion that the closest connection (r = 0.8) between values of temperature on various levels during the winter period in Keflavik is observed only in the lowest layer (earth -850 mbar).

Table 3. Mean values of correlation coefficients (r) between temperature at the surface of the earth and on isobaric surfaces in Keflavik.

Season	Earth – isobaric surface (mbar)								
	850	700	500	300	200	100	50	30	20
Winter	0,798	0,450	0,235	0,340	0,279	0,246	0,299	0,274	0,277
Summer	0,622	0,507	0,498	0,134	—0,299	—0,107	0,114	0,167	0,065

The correlation relationship between temperature at the surface of the earth and the levels situated above (700-500 mbar) is weak (r equal to 0.4 and 0.2), which once again stresses the high degree of temperature variability in the middle troposphere in this period which was noted above.

In the summer the connection between temperature at the surface of the earth and on an isobaric surface of 850 mbar is still less than in winter (r = 0.6). This is apparently connected, as already noted above, with the presence of considerable recurrence of inversions in the surface layer. In the middle troposphere, as a result of the greater stability of processes, in the region of Keflavik in the summer period the coefficients of correlation have somewhat raised values (r = 0.5). Unfortunately, for Sapporo we do not have the data on correlation coefficients.

As a result of grouping surface temperature by gradations we obtained the average profiles for each of them (Fig. 1 and 2). It turned out that the vertical course of temperature inside each gradation in broad terms is analogous to the course of the general average temperature regardless of the grouping at the surface of the earth. Values of vertical temperature gradients for the indicated profiles in the troposphere differ somewhat, however, the curves do

not cross and the least (the largest) mean values of temperature in the troposphere correspond to the least (the largest) mean values of it at the surface of earth. As can be seen in Fig. 1, only from an altitude of 9-10 km the temperature curves cross. In the lower stratosphere the mean values of each surface gradation of temperature are sufficiently close or coincide with the mean yearly temperature. Thus, only in the troposphere as a result of grouping of surface temperature there is a vertical separation of the region with more concrete values of temperature.

For clarification of the question of how expedient is the grouping of surface temperature, comparisons were made on the corresponding levels of the temperature values from individual radio balloon flights with the average temperature for the given gradation at the surface of the earth, and also with the general average temperature regardless of its values at the surface of the earth. Separate results of comparisons for Sapporo in the winter and in the summer are given in Table 4, where the differences in the values of the stated temperatures are given. For a comparison cases were selected with ground temperature corresponding to extreme gradations of temperature at the earth.

Table 4. Differences between values of temperature of individual flights (t_1), average temperature for a given extreme gradation (t_2), and the general average temperature (t_3) at the surface of earth and on the main isobaric surfaces for Sapporo.

Date	Difference	Earth	850 mbar	700	500	300	200	100
26. I 1957	t_2-t_1 t_3-t_1	−1,2 −6,2	−3,7 −7,6	−2,7 −6,7	1,7 −1,6	1,7 1,8	5,3 5,2	−1,5 −0,8
1. VI 1960	t_2-t_1 t_3-t_1	1,7 9,6	3,9 9,5	3,0 10,8	2,0 7,0	0,3 7,0	−0,8 0,9	−2,0 −5,5
20. VIII 1960	t_2-t_1 t_3-t_1	−1,1 −3,2	−1,9 −3,5	0,2 −1,4	−1,1 −2,5	−2,0 −4,0	3,0 2,5	−1,9 −0,5
15. II 1961	t_2-t_1 t_3-t_1	1,0 6,0	5,0 9,3	6,5 10,0	5,6 8,2	−4,5 −5,0	−8,6 −9,1	−7,1 −7,6
22. II 1961	t_2-t_1 t_3-t_1	−1,3 −3,7	0,6 −3,1	−0,2 −3,8	1,5 −4,9	−1,6 1,6	−5,4 7,1	−2,9 3,5

The results obtained (Table 4) indicate that the differences between temperature of an individual flight and the averaged temperature for the assigned gradation at the surface of earth in the troposphere is less than the differences between temperature of an individual flight and the average temperature regardless of grouping at the surface of the earth. Using the general average temperature (without grouping at the earth), we allow an error of from 3 to 10°, i.e., 2-3 times larger than when using the average temperature for gradation of ground temperature taken separately. This takes place in the troposphere up to an altitude of 5 km in winter and up to 9 km in the summer. The resulting conclusion pertains only to extreme and adjacent to extreme gradations of ground temperature which is close to its extreme values.

Analogous comparisons were made for separate cases of sounding with values of ground temperature found within the limits of the mean gradation of the distribution curve (Table 5). These data show that the temperature of individual flights (t_1) is closer to the averaged temperature for the given gradation (t_2) than to the general average temperature (t_3), but only in the lowest layer of the troposphere.

Table 5. Comparison of value of temperature of individual flights (t_1), averaged temperature for the given mean gradation (t_2), and the general average temperature (t_3) at the surface of the earth and on the main isobaric surfaces, Sapporo.

Date	Difference	Earth	850 mbar	700	500	300	200	100
17. VII 1960	t_2-t_1	0,0	−1,9	1,2	1,6	4,7	1,7	−3,4
	t_3-t_1	−2,1	−3,5	−0,4	0,2	2,7	1,2	−2,1
23. VII 1961	t_2-t_1	−1,4	−2,2	−3,4	−5,1	−7,5	−0,6	2,4
	t_3-t_1	1,5	−1,3	−2,6	−4,7	−6,6	−0,3	2,5

In the middle and upper troposphere the relationship of differences in temperature indicates that temperature for separate cases is closer to the values of temperature calculated independently of

the grouping by gradations at the surface of the earth.

Analogous results were obtained for stations at Keflavik in the winter when, as was shown above, a great degree of variability of temperature is observed. Consequently under the condition of considerable variability of ground temperature the conclusions pointed out can be extended to an equal degree both to regions with relatively low values of temperature and to regions with higher values of temperature at the surface of the earth.

The results were different for Keflavik in the summer. As it was shown (Table 2), in Keflavik the variability of surface temperature is small, so that range of its fluctuations comprises 25°. With the exception of single extreme valves of all temperature, all the data of observations of ground temperature are grouped only into three five-degree gradations. The values of averaged temperature for each of the three ground gradations taken separately at the corresponding altitudes are relatively close to the values of general average temperature regardless of grouping at the surface of the earth (Fig. 2). Thus, grouping of ground temperature when it has little variability at the surface of earth does not ensure sufficient concretization in the distribution of temperature with altitude and therefore cannot be considered expedient in this case.

Figure 3 gives the data of standard deviations of temperature for each gradation at the surface of the earth. In comparing the vertical course of this characteristic of temperature with the course of analogous values obtained independently of grouping at the surface of earth, it is necessary to note their identity in the nature of distribution with height.

The value of standard deviation of temperature for each gradation at the surface of the earth in the lower and middle troposphere is approximately 1.2-1.5 times less than the standard deviation of general average temperature regardless of grouping at the earth. In Keflavik in the summer during low variability of temperature, where the averaged temperature for each surface gradation on corresponding

heights is close to the general average temperature, the range of their fluctuations is naturally close to the general limit of fluctuations of temperature.

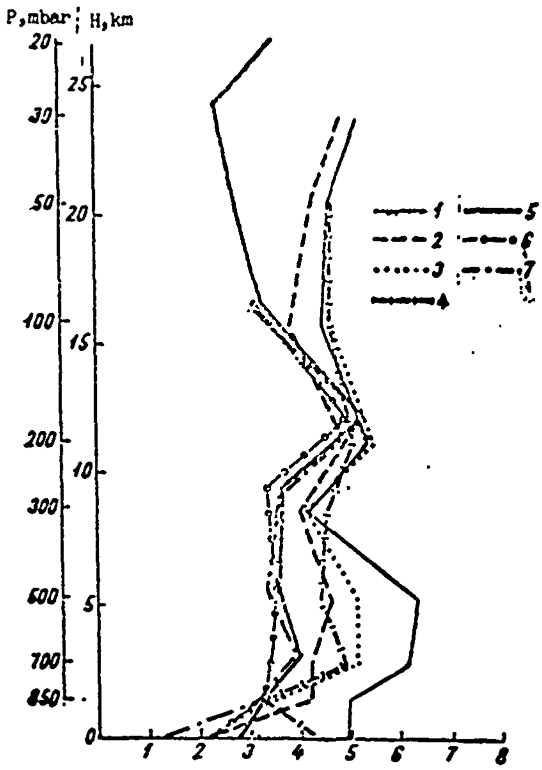

Fig. 3. Standard deviation of temperature σ_t at Sapporo, winter (1-4) and Keflavik, summer (5-7). (1 and 5 – obtained independently of grouping of temperature at the surface of earth; obtained for assigned gradation of ground temperature: 2 – from 0.0 to -4.9°; 3 – from -0.1 to -4.9°; 4 – from -5.0 to -9.9°; 6 – from -10.0 to 14.9°; 7 – from 5.0 to 9.9°).

Conclusions

Grouping of ground temperature when it has a high degree of variability in the shown points specifies the vertical distribution of temperature in the troposphere only for extreme and close to extreme gradations of temperature at the surface of the earth. The vertical course of average temperature in these gradations reflects 2-3 times more accurately the vertical stratification than general average temperature (independent from grouping at the surface of

the earth). With small temperature variation at the surface of the earth the division of ground temperature by gradation is not expedient.

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Appendix 1. Recurrence of temperature (%), obtained independently of grouping of temperature at the surface of the earth in Keflavik (K) and Sapporo (S) in winter

Isobaric surface (mbar)		Gradation of temperature																					Average temperature	σ_t
		10.0–14.9	5.0–9.9	0.0–4.9	от −0.1 до −4.9	от −5.0 до −9.9	от −10.0 до −14.9	от −15.0 до −19.9	от −20.0 до −24.9	от −25.0 до −29.9	от −30.0 до −34.9	от −35.0 до −39.9	от −40.0 до −44.9	от −45.0 до −49.9	от −50.0 до −54.9	от −55.0 до −59.9	от −60.0 до −64.9	от −65.0 до −69.9	от −70.0 до −74.9	от −75.0 до −79.9	от −80.0 до −84.9	от −85.0 до −89.9		
Earth	K		11	46	30	13	0																0,2	4,3
	S	1	5	21	43	26	4	0															−2,5	4,9
850	K			5	21	44	20	9	1														−8,0	5,1
	S			2	9	26	42	21	0														−11,0	4,9
700	K				2	16	24	32	19	7	0												−16,0	6,1
	S				1	7	16	31	28	16	1	0											−19,0	6,1
500	K						0	1	12	29	26	25	7	0									−31,2	6,1
	S							0	8	20	35	24	13	0									−33,2	6,3
300	K											0	2	15	49	30	4	0					−53,4	4,3
	S											1	5	22	54	18	0						−51,6	4,1
200	K												1	12	24	27	17	15	3	1			−57,9	7,1
	S											1	10	31	33	15	5	0					−51,0	5,3
100	K													1	25	26	29	16	3	0			−59,6	5,8
	S												5	26	44	23	2						−52,0	4,4
50	K													1	9	22	19	20	21	7	0		−61,7	7,8
	S											1	9	47	28	14	1						−49,9	4,5
30	K													5	8	11	15	16	23	21	1		−66,8	9,0
	S											9	33	32	21	5							−46,5	5,1
20	K													5	7	14	14	13	25	17	4		−67,0	9,3
	S																							

[от — from; до — to].

Appendix 2. Recurrence of temperature (%), obtained independently of grouping of temperature at the surface of the earth in Keflavik (K) and Sapporo (S) in the summer.

Isobaric surface (mbar)		Gradation of temperature																					Average temperature	σ_t
		30,0—34,9	25,0—29,9	20,0—24,9	15,0—19,9	10,0—14,9	5,0—9,9	0,0—4,9	от —0,1 до —4,9	от —5,0 до —9,9	от —10,0 до —14,9	от —15,0 до —19,9	от —20,0 до —24,9	от —25,0 до —29,9	от —30,0 до —34,9	от —35,0 до —39,9	от —40,0 до —44,9	от —45,0 до —49,9	от —50,0 до —54,9	от —55,0 до —59,9	от —60,0 до —64,9	от —65,0 до —69,9		
Earth	K			0	2	62	35	1															10,5	2,7
	S	3	10	41	34	11	1																20,4	4,8
850	K					1	19	65	14	1													2,8	3,2
	S			2	34	47	13	4															13,4	4,1
700	K						0	6	37	50	7	0	0										—5,4	3,9
	S					9	51	30	7	2	1												5,2	4,5
500	K									0	4	36	53	7	0								—20,6	3,5
	S								14	47	28	9	2										—9,4	4,5
300	K															2	25	57	15	1			—46,9	3,6
	S												0	18	39	24	15	4					—34,9	5,4
200	K															3	41	31	18	6	1		—46,8	5,2
	S															0	4	37	45	13	1		—51,0	4,0
100	K														0	0	33	61	6	—	0		—46,1	3,2
	S																	0	17	40	34	9	—59,2	4,3
50	K																48	50	2				—45,2	2,7
	S																1	15	57	26	1		—53,0	3,5
30	K															3	79	17	1				—43,3	2,3
	S															2	23	54	20				—47,2	3,6
20	K														6	46	40	8					—40,0	3,6
	S														4	15	38	42	1				—43,6	6,2

[от — from; до — to].